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(54) Lock and method of locking

(57) A lock has rotary tumblers (18, 19) mounted inside a barrel (11) which is rotatable in a housing (10). A clutch mechanism (21, 29) is provided for releasably coupling with the barrel (11) a key which has been inserted into the lock. When the clutch mechanism is in a driving condition, torque can be transmitted from the key to the barrel other than via the tumblers and a locking roller (16) can be carried by the barrel around the interior of the housing to a recess (28) in which the roller can engage to deadlock the barrel to the housing.

Fig. 3.

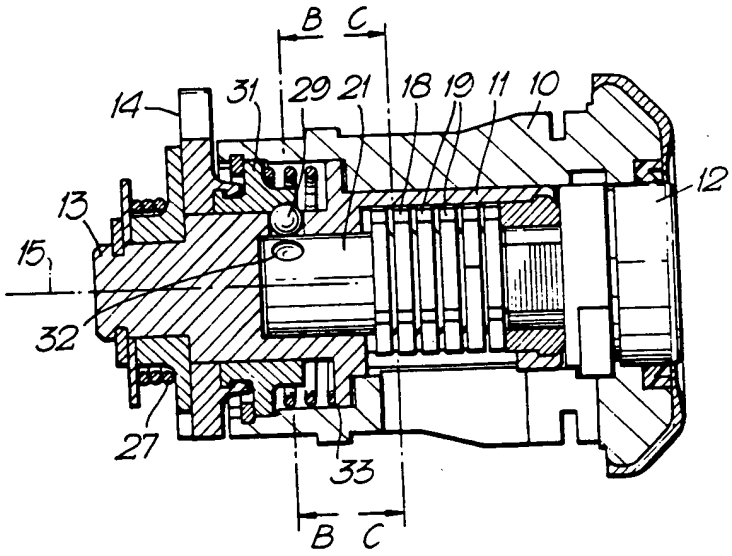
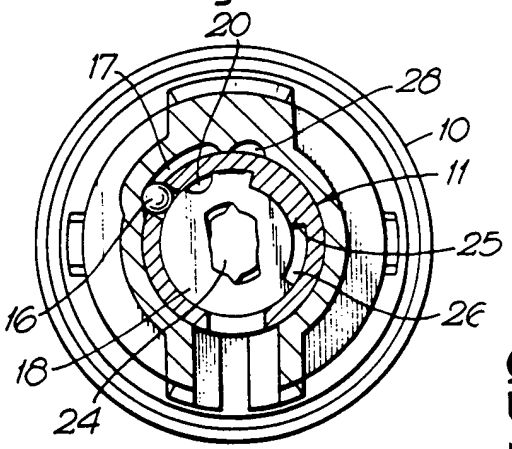


Fig. 5.



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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

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Fig. 3.

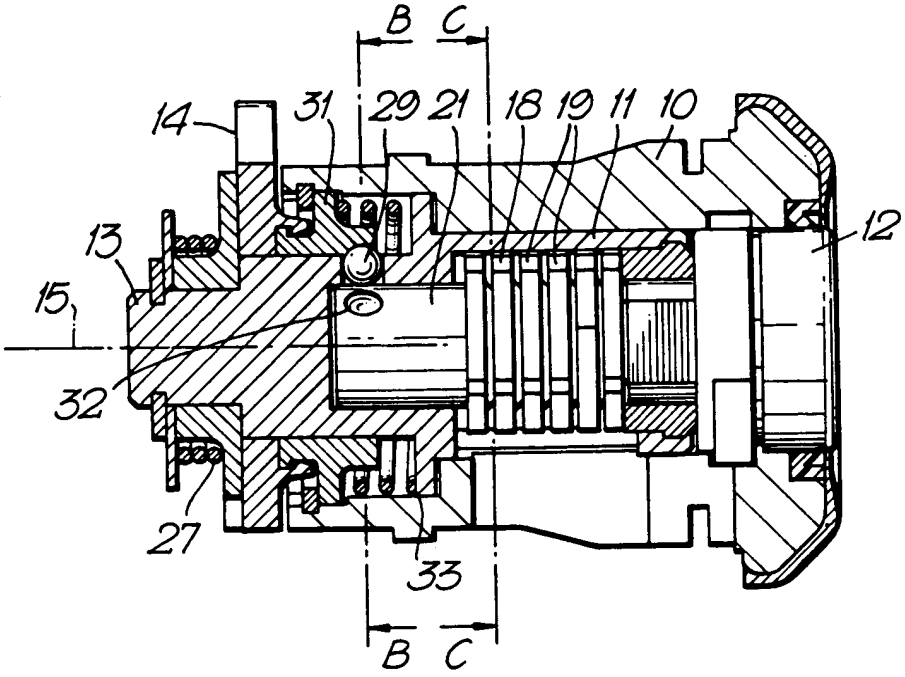

Fig. 4.

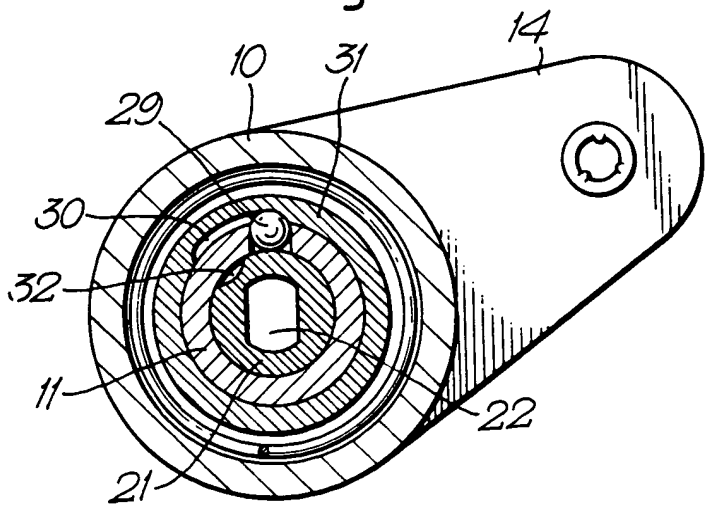

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Fig.1.

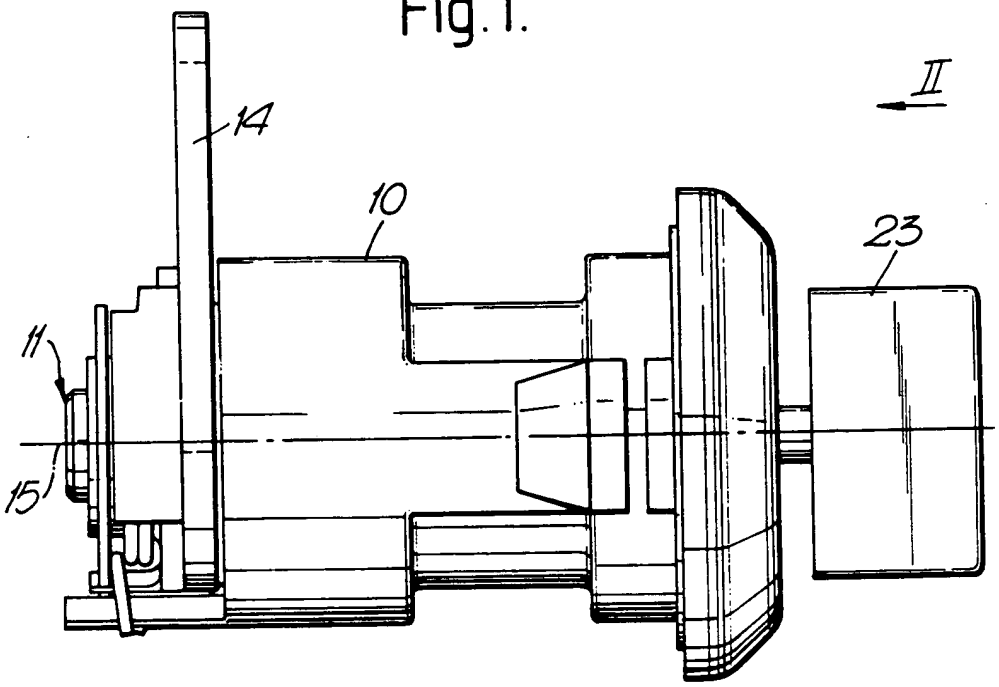

Fig.2.

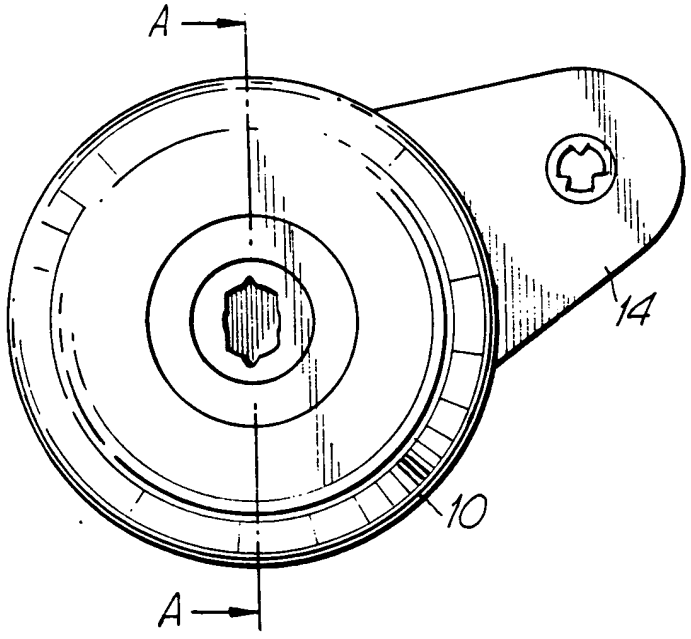

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Fig.5.

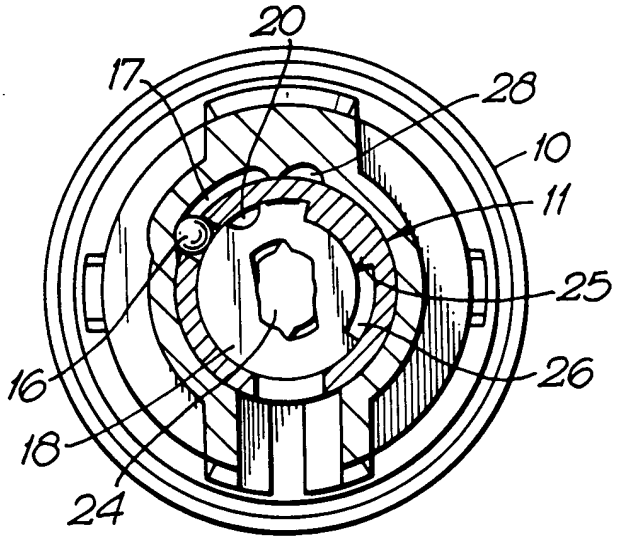


Fig.6.

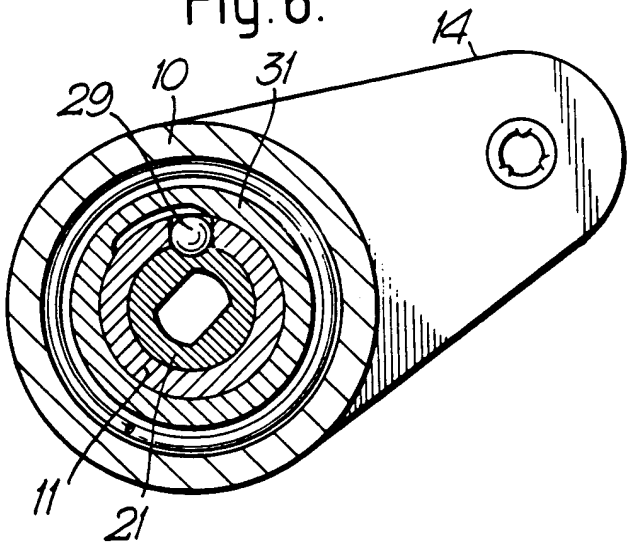
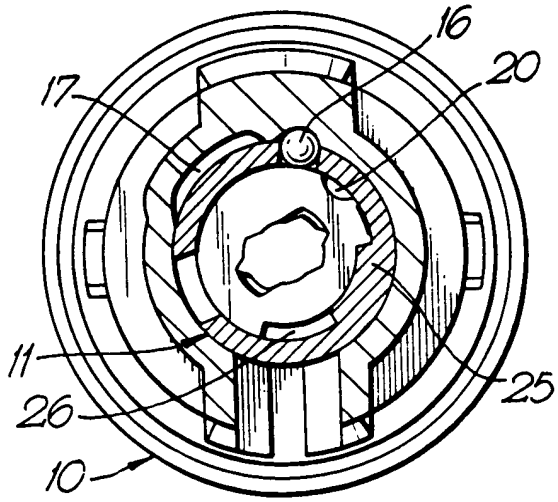


Fig. 7.



The barrel is preferably turnable by means of the key and clutch mechanism into a position in which the barrel can be locked against turning relative to the housing, thereby providing a deadlocking action for any mechanism drivingly associated with the barrel. The invention can be advantageously applied to a door lock having a barrel so connected with a bolt or other fastening element that turning of the barrel in a first direction from a datum position moves the fastening element to a releasing position and turning of the barrel in a second direction from the datum position moves the fastening element to a locking position. In accordance with the present invention, provision may be made for turning the barrel by means of the key and clutch mechanism in the second direction to a position where the barrel can be locked to the housing. If this locked position of the barrel corresponds to the locking position of the fastening element and the linkage prevents movement of the fastening element unless the barrel is turned from its locked position, then the fastening element will be deadlocked.

In accordance with a second aspect of the invention, there is provided a method of locking a closure provided with a lock having a hollow housing, a barrel mounted in the housing for turning relative thereto about an axis of the lock and a plurality of tumblers mounted in the barrel for turning relative thereto about the axis, the method comprising the steps of inserting a key into the lock, turning the key through a first angle in a first direction to turn the tumblers in said first direction through respective angles, at least one of which is smaller than the first angle, moving the key along its axis of rotation relative to the housing to couple the key with the barrel, turning the key and the barrel together through a second angle in a second direction, uncoupling the key from the barrel, turning the key further in the second direction to deadlock the barrel with respect to the housing and withdrawing the key from the lock.

An example of a lock embodying the first aspect of the present invention and which is used in a method according to the second aspect will now be described, with reference to the accompanying drawings, wherein:-

FIGURE 1 shows a side elevation of the lock and of a key in the lock;
FIGURE 2 shows an end view of the lock on the arrow II of Figure 1;
FIGURE 3 shows a cross-section on the line AA of Figure 2,
FIGURE 4 shows a cr ss-section on the line BB of Figure 3;
FIGURE 5 shows a cross-section on the line CC of Figure 3;

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Title: Lock and method of locking"

Description of Invention

From one aspect, the present invention relates to a lock of the kind comprising a hollow housing, a barrel mounted in the housing for turning relative to the housing about an axis of the lock and a plurality of tumblers which are movable relative to the barrel by means of a proper key into respective releasing positions, turning of the barrel relative to the housing being prevented or restricted whilst the tumblers are out of their releasing positions and being permitted or being less restricted when the tumblers are in their releasing positions.

There are known locks wherein the key engages the barrel in a manner such that torque can be applied directly from the key to the barrel for turning the barrel, once the tumblers have been set in their releasing positions. There are also known locks wherein torque is transmitted to the barrel via one or more tumblers. In locks of the latter kind, the key can undergo limited turning relative to the barrel, for example to set the tumblers in their releasing positions.

According to a first aspect of the present invention, there is provided in a lock of the kind described a clutch mechanism for releasably coupling the key with the barrel in a manner to transmit torque from the key to the barrel. Whilst the clutch mechanism is in a non-driving condition, a key which has been introduced into the lock can be turned relative to the barrel. When the clutch mechanism has been set in a driving condition, torque can be transmitted from the key to the barrel other than via one or more tumblers.

The clutch mechanism is preferably settable in a driving condition by axial movement of the key and the barrel relative to the housing. The barrel may be urged by a spring in one direction relative to the housing, for setting the clutch mechanism in a non-driving condition, the barrel being movable by means of the key against the action of the spring in the opposite axial direction to set the clutch mechanism in the driving condition.

FIGURE 6 shows a cross-section on the line BB after a key has been applied to the lock, turned through an angle of 45° and moved along the axis of rotation of the key; and

FIGURE 7 shows a cross-section on the line CC with a barrel of the lock deadlocked to a housing of the lock;

The lock comprises a hollow housing 10 in which there is disposed a hollow barrel 11. A front end portion 12 of the barrel is accessible at one end of the housing and may protrude somewhat from the housing. A rear end portion 13 of the barrel also protrudes from the housing. On this rear end portion, there is fixed an arm 14 which projects from the barrel in a direction perpendicular to an axis 15 of the barrel. The arm is connected by a linkage (not shown) in a known manner with a door latch mechanism (also not shown).

The latch mechanism may be a known latch mechanism of a vehicle door, in which case the housing 10 of the lock is fixed in a known manner in an aperture defined by the door. The latch mechanism includes a bolt or other fastening element for fastening a latch in a projected position. By turning of the arm 14 in a clockwise direction, as viewed from the front of the lock, from the datum position of Figures 1 to 4 the fastening element can be set in a locking position, in which it prevents retraction of the latch. Turning of the barrel in the anti-clockwise direction from the datum position withdraws the locking element from its locking position, so that retraction of the latch is permitted. In known arrangements, the arm is typically returned to its datum position after the locking element has been set either in the locking position or in the withdrawn position. When in the datum position, the arm and associated linkage does not interfere with movement of the locking element so that the locking element can be moved between its locking and withdrawn positions by other means, for example by means of a knob at an inside of the door in which the lock is mounted or by means of an electrically energisable actuator.

The lock illustrated in the accompanying drawings is so arranged that the barrel 11 can be held in a position different from the datum position, even in the absence of the key. The position in which the barrel can be held is called herein the deadlocked position and the barrel is turned in the clockwise direction, as viewed from the front of the lock, in order to return the barrel from the d adlocked position to the datum position.

The barrel 11 has cylindrical external surface portions engaged in sliding contact with corresponding internal surface portions presented by the housing 10 so that the barrel is supported for turning relative to the housing about the axis 15. For controlling turning of the barrel relative to the housing, there is provided a locking element in the form of a roller 16 which is mounted in an opening in a circumferential wall of the barrel. That dimension of the roller 16 which extends in a direction radially of the axis 15 is substantially greater than the corresponding dimension of the wall of the barrel, so that the roller must protrude radially from its opening in the wall. There is formed in the internal surface of the housing 10 a recess 17 for receiving a protruding portion of the roller, as shown in Figure 5. The recess 17 subtends at the axis 15 an angle somewhat greater than 45°, so that turning of the barrel relative to the housing 10 whilst the roller protrudes into the recess 17 is restricted to an angle of 45°. As shown in Figure 5, when the barrel is in the datum position, the roller 16 lies at one end of the recess 17 and turning of the barrel in the clockwise direction causes the roller to move along the recess.

A number of tumblers are mounted inside the barrel 11, these tumblers being arranged in a row extending along the axis 15. One of the tumblers is shown in Figure 5 and is identified by the reference number 18. Other tumblers are indicated at 19 in Figure 3. The tumblers are arranged for turning relative to the barrel 11 about the axis 15 and have respective surface portion which are in sliding contact with or which are close to the internal surface of the barrel wall portion in which the roller 16 is mounted. When these surface portions of the tumblers span the opening containing the roller 16, they prevent the roller protruding from the barrel wall in a direction towards the axis 15 and maintain the roller partly in the recess 17 so that turning of the barrel in a clockwise direction from the datum position is prevented. Positions of the tumblers in which cylindrical surface portions of the tumblers span the opening containing the roller 16 and prevent the roller protruding from the barrel wall towards the axis 15 are called herein locking positions of the tumblers.

Each tumbler has at its periphery a recess 20 for receiving a part of the roller 16 when the tumbler is in a releasing positi n, that is to say when the recess 20 is aligned with the opening in the barrel wall containing the roller 16. The dimensions of the recess 20 are such that, with all of the tumblers in respective releasing positions, the roller 16 can move out of the recess 17 to

lie partly in the opening in the barrel wall and partly in the recesses of the tumblers.

There is also disposed inside the barrel 11 a transmission element 21 of generally cylindrical form which is arranged for turning relative to the barrel about the axis 15. The transmission element lies further from the front of the lock than do the tumblers and is formed with a non-circular socket 22 for receiving a free-end portion of a stem of the key 23, when the stem is inserted into the lock. This end portion of the key has a shape complementary to that of the socket, so that the key is coupled in torque-transmitting relation with the element 21. The free-end portion of the key and the socket preferably have tapered shapes to provide for automatic alignment of the element 21 with the key, during insertion of the key.

Each of the tumblers has a central opening 24, through which the axis 15 extends. The opening 24 is of sufficient size to allow the free-end portion of the stem of the key to pass through the openings of the tumblers to the transmission element 21. The shape of the opening in each tumbler and the positional relation between the boundaries of that opening and the recess 20 of the tumbler vary from one tumbler to another. The stem of the proper key for operation of the lock has surface portions arranged according to the configurations of respective tumblers. If, with the barrel 11 in the datum position and the tumblers in locking postions, as shown in Figure 5, the stem of the proper key is introduced into the socket 22 and is then turned in the clockwise direction, as viewed from the front of the lock, the key will initially turn relative to at least some of the tumblers but before the key has turned through an angle of 45^{o}, engagement between the key and the boundary surfaces of the openings 24 of the tumblers will cause all of the tumblers to turn with the key until the tumblers simultaneously reach their releasing positions. When the tumbler 18 reaches its releasing position, a radially inwardly projecting ear 25 formed on the barrel 11 is engaged by a surface 26 of the tumbler 18 which lies in a plane containing the axis 15 and which defines one boundary of a peripheral recess 26 formed in the tumbler. This establishes a torque-transmitting relation between the tumbler 18 and the barrel so that continued turning of the key transmits drive through the tumbler 18 to the barrel. The roller 16 is thereby urged against a boundary of the recess 17. Since this boundary has the form of a ramp and is inclined at an acute angle to an adjacent tangent t the barrel, the roller 16 is forced towards the axis 15 out of the recess 17 to protrude into the recesses 20 of

the tumblers. The barrel then participates in continued turning of the key in the clockwise direction and the arm 14 is turned about the axis 15 to set the locking element of the latch mechanism in its withdrawn position. The key can then be turned in the anti-clockwise direction, eventually entraining the tumblers so that the tumblers carry the roller 26 towards the recess 17 of the housing. Until the roller reaches the recess 17, it lies partly in the opening in the barrel wall and partly in the recesses 20 of the tumblers so that the barrel is entrained by the tumblers. Once the roller reaches the recess 17, it is driven away from the axis 15 by a caming action of the tumblers until the roller and barrel are no longer entrained by the tumblers. Continued turning of the key in the clockwise direction brings the tumblers into the locking position illustrated in figure 5.

Continued turning of the key in the clockwise direction causes the barrel 11 to be entrained by the tumbler 18, since the ear 25 has reached a boundary of the recess 26, so that the barrel can be turned anti-clockwise from the datum position to set the locking element of the latch mechanism in the locking position. It will be noted that anti-clockwise turning of the barrel from the datum position is not prevented, because the roller 16 can move along the recess 17. Turning of the barrel in the anti-clockwise direction from the datum position to achieve locking of the associated latch mechanism can be effected by insertion of the proper key into the lock or by insertion of another key or instrument which is incapable of moving the tumblers to their releasing positions, but is capable of entering the central openings 24 of the tumblers and of transmitting torque in the clockwise direction to the tumbler 18.

A torsion spring 27 is provided to return the arm 14 and the barrel 11 to the datum position when the key is released by the operator or when the key is withdrawn from the barrel.

It is desirable that movement of the barrel 11 to the deadlocked position should be possible only by means of the proper key and not by means of all instruments capable of exerting torque on the tumbler 18. Accordingly the lock is so arranged that the tumblers must be moved into their releasing positions before the barrel can be turned to the deadlocked position illustrated in Figure 7. The deadlocked position is defined by a further internal recess 28 in the housing 10. The recess 28 is spaced somewhat circumferentially of the housing from the recess 17 and has a circumferential extent which is only just sufficient to accommodate the protruding portion of

the roller 16. Accordingly, movement of the barrel 18 about the axis 15 relative to the housing 10 is prevented when the roller 16 lies partly in the further recess 28 and partly in the opening of the barrel wall, with the tumblers in respective locking positions relative to the barrel, as shown in Figure 7.

To set the barrel in the deadlocked position, the stem of the key is introduced through the tumblers into the socket 22 of the transmission element and the key is then turned in the clockwise direction, as viewed from the front of the lock, to move the tumblers into their releasing positions and to expel the roller 16 from the recess 17 to lie partly in the recesses 20 of the tumblers. The key is then coupled with the barrel 11 other than via the tumblers so that the barrel can be turned by means of the key in the opposite direction without the application of torque to the roller 16, such as would tend to expel the roller from the recesses 20 of the tumblers into the recess 17 of the housing. The torque-transmitting relation is established by a clutch mechanism, a driving element of which is constituted by the transmission element 21. The clutch mechanism further comprises a ball 29 which occupies the further opening in the barrel wall, this opening being formed in that part of the barrel which surrounds the transmission element 21. When the barrel is in the datum position of Figure 5, the circumferential surface of the transmission element spans the opening in which the ball 29 is disposed and prevents protrusion of the ball from the barrel wall in a direction towards the axis 15. A portion of the ball protrudes from the outside of the barrel wall into an arcuate recess 30 formed in a bush 31 mounted in the housing 10. The arcuate extent of the recess 30 corresponds to that of the recess 17, so that the recess 30 permits turning of the barrel and ball 29 together from the datum position in the clockwise direction, to effect locking of the associated latch mechanism.

A circular recess 32 is formed in the external surface of the transmission element 21. As shown in Figure 4, when the transmission element 21 is in the datum position, in which the key is inserted and withdrawn, the recess 32 is spaced circumferentially from the ball 29. Turning of the inserted key in the clockwise direction to move the tumblers into respective releasing positions brings the recess 32 into alignment with the ball 29, as shown in Figure 6. The key, barrel 11 and transmission element 21 can then be moved along the axis 15 relative to the housing 10 in a rearwards direction. Such mov ment drives the ball 29

against a curved boundary wall of the recess 30 so that the ball is driven by a caming action towards the axis 15 and partly into the recess 32. As shown in Figure 6, the ball 29 then no longer protrudes from the outside of the barrel wall 11. Whilst the barrel remains in its axially inner position, movement of the ball 29 out of the recess 32 in the transmission element is prevented by an internal surface of the housing 10 and the key remains coupled in torque-transmitting relation with the barrel 11.

Once the clutch mechanism has been set in a driving condition, the key can be turned in the anti-clockwise direction sufficiently to move the roller 16 past the recess 17 into alignment with the recess 28 in the housing. As the roller 16 moves into alignment with the recess 28, the ball 29 moves into alignment with a part of the recess 30 in the housing and is no longer held in the recess 32. Continued application of torque in the anti-clockwise direction to the key causes the ball 29 to be driven away from the axis 15 by a caming action of the transmission element 21 so that the ball is expelled from the recess 32 to lie partly in the recess 30. The clutch mechanism is then no longer capable of transmitting torque between the key and the barrel 11. Torque applied in the anti-clockwise direction to the key by the operator is transmitted by the tumblers to the roller 16 and the roller is expelled from the recesses 20 of the tumblers by a caming action. The roller is thereby moved away from the axis 15 to lie partly in the recess 28 of the housing and so hold the barrel 11 against turning relative to the housing from the deadlocked position. As the roller 16 leaves the recesses 20 of the tumblers, the tumblers are freed for turning in the anti-clockwise direction relative to the barrel 11 until the ear 25 on the barrel comes into engagement with a boundary surface at one end of the recess 26 in the tumbler 18. Further turning of the tumblers and key in the anti-clockwise direction is thereby prevented and the key is withdrawn from the lock, leaving the tumblers in respective locking positions. The barrel is moved forwards along the axis 15 by a compression spring 33 interposed between the barrel and the bush 31.

The barrel 11 can be turned from the deadlocked position by insertion of the key into the lock and turning of the key in to the clockwise direction, as viewed from the front of the lock, to carry the tumblers into respective releasing positions, in which the recesses 20 of the tumblers are aligned with the roller 16. When the tumblers are in their releasing positions, the ear 25 on the barrel is engaged with a boundary surface at one end of the recess 26 in the tumbler 18 so that torque in the clockwise direction can

CLAIMS:-

1. A lock comprising a hollow housing, a barrel mounted in the housing for turning relative thereto and a plurality of tumblers movable by means of a proper key relative to the barrel into respective releasing positions, wherein there is provided a clutch mechanism for releasably coupling the key with the barrel in a manner to transmit torque from the key to the barrel.

2. A lock according to Claim 1 wherein the clutch mechanism is settable in a driving condition by axial movement of the barrel relative to the housing.

3. A lock according to Claim 2 further comprising a spring arranged to urge the barrel axially relative to the housing for setting the clutch mechanism in a non-driving condition.

4. A lock according to any preceding Claim wherein the clutch mechanism comprises a clutch element which is movable towards and away from the axis of the lock between a torque-transmitting position and a position in which torque cannot be transmitted from the key to the barrel via the clutch element.

5. A lock according to any preceding Claim wherein the clutch mechanism further comprises a transmission element which is mounted in the barrel for rotation relative thereto about a lock axis when the clutch mechanism is in the non-driving condition and which defines a socket for receiving a portion of the key, when applied to the lock.

6. A lock according to Claim 5, as appendant to Claim 4, wherein a recess is formed in a radially outwardly facing surface of the transmission element and wherein a part f the clutch element lies in said recess, when the clutch mechanism is in the driving condition.

7. A lock according to Claim 6 wherein there is formed in an internal surface of the housing a recess for receiving a part of the clutch element and

be transmitted from the key to the barrel via the tumbler 18. Turning of th key, tumblers and barrel together in the clockwise direction causes the roller 16 to be driven towards the axis 15 by a caming action of the housing 10 so that the roller is expelled from the recess 28 in the housing and comes to lie partly in the recesses 20 of the tumblers. The barrel can then be turned in the clockwise direction sufficiently to move the locking element of the associated latch mechanism to its withdrawn position. During turning of the barrel, the roller 16 is carried past the recess 17.

wherein said recess has a circumferential extent considerably greater than the corresponding dimension of the clutch element so that the clutch element can turn relative to the housing about the lock axis whilst remaining partly in the recess of the housing.

8. A lock according to any preceding Claim wherein an opening is formed in a wall of the barrel, the opening contains a locking element which is movable towards and away from the axis of the lock between a position in which the locking element protrudes from the barrel wall in a direction towards the lock axis only and a position in which the locking element protrudes from the barrel wall in a direction away from the lock axis only, wherein there is formed in each tumbler a recess to receive a protruding portion of the locking element when the tumbler is in its releasing position and the locking element protrudes from the barrel wall towards the axis and wherein there are formed in an internal surface of the housing two circumferentially spaced recesses for receiving the protruding portion of the locking element when the locking element protrudes from the barrel wall in a direction away from the axis.

9. A lock according to Claim 8 wherein one of the recesses formed in the housing for receiving the locking element has a greater circumferential extent than does the other of those recesses.

10. A lock substantially as herein described with reference to and as shown in the accompanying drawings.

11. Any novel feature or novel combination of features disclosed herein or in the accompanying drawings.

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